Chemotaxis

- The title will have already been added by the Bartleby team.
- Do not include this at the beginning of your article.
- Please let us know if there are issues with spelling or usage.

What is chemotaxis?

The organism's movement in a particular direction as a response to certain chemicals that are available in the environment is defined as chemotaxis. In brief, it can be defined as the occurrence of an organism's movement in response to a certain chemical stimulus.

"Quick Overview"
Heading 2 Styling
1-2 sentences

How do organisms use chemotaxis?

Chemotaxis is a phenomenon in which bacterial, somatic and certain single or multicellular organisms move in a particular direction due to the presence of a certain chemical in the environment. Chemotaxis occurs as a response to those chemicals. Chemotaxis plays a significant role in enabling bacteria to identify their food, and to protect themselves from poisonous molecules.

Bacteria tend to swim in the direction which has the highest concentration of the molecules of food in order to satisfy their hunger. In organisms that are multicellular, the chemotaxis phenomenon is considered to be critical to regular functions and development.

"Explanation"
3-5 topics
Heading 2 Styling

Use the "Must Have" keyword list and "Questions" widget to help you select the major topics.

Use simple language.

Make use of familiar comparisons, or real-world examples to examine the topic.

Types of chemotaxis

Chemotaxis is broadly classified into two significant types namely positive and negative chemotaxis.

Use the Heading 3 styling to organize ideas under subtopics.

Positive chemotaxis:

If the migration of the organisms and motile (moving) cells takes place in the direction **toward** the chemicals or the substances that are greater in concentration, this is called a positive chemotaxis.

Negative chemotaxis:

If chemotaxis takes place in the **opposite or alternate** direction to that of the chemical substances present in higher concentrations, this is called negative chemotaxis.

The process of chemotaxis

Chemotaxis, which is prevalent in organisms starting from bacteria up to human cells, involves two fundamental steps.

At first, the process of formation, which is the mechanism by the diffusion of the chemical's concentration gradient, takes place with the help of the chemotactic ligands.

Define any technical language.

The next step is the gradient sensation by a specific organism or the cell and the alternation of the movement direction accordingly. The movement can be either towards or away from the specific chemical.

Chemoattractants and Chemorepellants

Chemoattractants and chemorepellants are chemical substances that are either organic or inorganic and which possess the phenomenon of inducing the effect of chemotaxis in motile cells.

Chemoattractants exhibit their effects with the help of chemoreceptors. Methyl-accepting chemotaxis protein (MCP) is one such receptor. Galactose and ribose are examples of chemoattractants. Phenol is an example of a chemorepellant.

Spell out acroynms at their first occurrence, and then abbreviate consistently.

In the external cell domain of chemoattractants and chemorepellants, MCP is bounded and the domain within the cell helps to relay the variations in the concentration gradient of those ligands that are chemotactic and further follows the processes to achieve the movement of the cells or organism in a specific direction. As per the investigation, the mechanism behind the chemoattracts is well defined than that of the chemorepellants.

Open line

topic-name/topic-name-#

Include alt-text

[btbimg name="Chemotaxis/Chemotaxis-1.png " alt="Bacterial migration in response to Chemoattractants and chemorepellants"]

Use a placeholder where you plan to use images.

Open line

Bacterial Chemotaxis

E. Coli is a bacterium that contains four to ten flagella per cell. It is able to rotate in two distinct ways: clockwise and counterclockwise. The movement occurring via both rotations are called tumbling and swimming respectively. This movement is based on the alignment of flagella. The bacterium's overall motion includes both swimming and tumbling movement in an alternative manner.

When a gradient in chemical exists, chemotaxis will be carried out by a bacterium in which the gradient directs the bacterium for the direction of the movement. Based on the sensing by a bacterium, it tends to swim in a straight line for a long span of time before the movement of tumbling, if it moves towards the chemoattractant. If it senses its directional movement is towards the chemorepellent, it gets tumbled in a short span of time.

[btbimg name="Chemotaxis/Chemotaxis-2.png " alt="Movement of bacteria in relation to its rotation"]

Double-check that images are numbered in order and not repeated.

Each filament of flagella is helical in nature which is significant for the movement of the bacterial cells. The flagellin is the structure of the molecule of protein that constructs the filament of flagella. It is in conservation in all the bacteria that are flagellated. However, in biology, it is not always standard among all organisms. Some bacteria, for example, Vibrio which are called monoflagellated and contain only a flagellum at a cell's pole. In this case, chemotaxis occurs in a varied manner.

Eukaryotic chemotaxis

The chemotaxis phenomenon is entirely different in eukaryotes when compared to prokaryotes. Though the sensing of the gradient of chemical remains a significant step in both organisms. Prokaryotes like bacteria are smaller in size and thus they are not capable of identifying the concentration gradient in a direct way. They utilize a temporal method to sense the environment and further swims and redirect on their own whenever they observe the modifications in the gradient. But in the case of eukaryotes, as they are larger in size than prokaryotes, they have several receptors that are uniformly embedded over the membrane off the cell. This involves a spatial method of sensing the gradient of concentration. This is achieved by the comparison between the receptor activation in an asymmetric way at varying cell ends. Thus, these receptor's activation aids in the directional movement towards the chemoattracts or away from the chemorepellants. In eukaryotic cells, chemotaxis plays an important role in the movement of immune cells and in the initial embryogenic phase. In the early stage of the embryogenic phase, the germ layers are developed by the guidance of the signal molecule's gradient.

Examples

The motility in the cells of eukaryotes is not clear yet as like bacterial movement. It appears to be that it carries out a mechanism that involves the sensing of an external gradient of chemotactic ligands and is converted into a PIP3 gradient which is intracellular. This then activates the pathway for signaling and ends in the polymerization of the filament of actin molecules.

[btbimg name="Chemotaxis/Chemotaxis-3.png " alt="Sperm chemotaxis"]

Measuring Chemotaxis

The activity of chemotaxis in the cells can be evaluated by several broad techniques. The measurement requires four significant essentials:

- The ability of the gradient of concentration to develop relatively in a fast manner and can able to stand for a longer period of time in a particular system
- The distinction between the chemokinetic and chemotactic mechanisms
- The cell's movement is independent towards or away on the specific concentration gradient axis
- The response detected are the finalized results of the active cell's movement.

The ideal method of assay is not yet discovered, however, agar-plate assays, two-chamber assays, and certain other techniques such as the T-maze technique, orientation assay offer better results.

Common Mistakes (Recommended)

"Common Mistakes"
Heading 3 Styling

Formulas

"Formulas"
Heading 3 Styling
Use MathType
Define variables

Context and Applications

This topic is significant in the professional exams for both undergraduate and graduate courses, especially for

B.Sc. in Biology

B.Sc in Microbiology

M.Sc in Microbiology

Masters in Microbial Biotechnology

"Context and Applications"
3-5 topics
Heading 2 Styling

Related Concepts

Motility
Fertilization
Durotaxis
Haptotaxis
Mechanotaxis

"Context and Applications"
Optional
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